A SOCIAL PERSPECTIVE OF RECYCLING

IN ALBERTA

Alberta
ENVIRONMENT COUNCIL OF ALBERTA

86-020347

Terms of Reference

FOR PUBLIC HEARINGS ON THE RECYCLING OF WASTE WITHIN THE PROVINCE OF ALBERTA

The Environment Council of Alberta is hereby requested to:

1) Enquire into the potential for the economic recycling of products presently disposed of as wastes; giving particular attention to:

   a) the potential, scope and obstacles to increased recycling by private sector business enterprises;

   b) the potential, scope and obstacles to increased recycling by volunteer organizations;

   c) the support role of local governments and the provincial government in facilitating recycling by the private sector and volunteer organizations, considering the potential reduction in waste disposal costs, the enhancement of the environment and privatization.

2) Consider the potential and comparative economics of the generation of energy from wastes when the alternative of the creation of useful goods and services from wastes is not feasible.

3) Hold public hearings at suitable locations throughout the province, and report to the Minister of Environment and the Lieutenant-Governor in Council on completion of the report.

– Order In Council 106/85

A Social Perspective of Recycling in Alberta

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January 1986

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This report may be cited as:

Free, B. 1986. *A Social Perspective of Recycling in Alberta.* ECA86-18/IB5. Edmonton: Environment Council of Alberta. 21 pages.

ECA86-18/IB5

Preface

The Government of Alberta has asked the Environment Council of Alberta to hold public hearings on recycling of waste in Alberta. In particular, the Environment Council is to investigate the potential, scope, and obstacles to increased recycling as well as the potential for generating energy from waste should other alternatives be unsuitable.

As part of its preparation for these public hearings, the Environment Council has prepared a series of reports dealing with various aspects of recycling. In this report, recycling is examined from a social perspective. What is the role of public attitude and personal motivation? What are some of the social costs and benefits of recycling? Current recycling activities in Alberta are described, and options for the future are discussed.

This report is intended to aid the reader in identifying concerns and developing suggestions about the future of recycling in Alberta. The Environment Council's public hearings will assist the Government of Alberta in determining future directions and policies to enhance recycling and improve waste management. *Your* input is needed to make this process work. Whether your experiences with recycling have been favorable or not, the Council would like to know so it can identify those factors that facilitate recycling, and those that hinder it.

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1. INTRODUCTION

In Alberta, as everywhere in our western society, people enjoy buying new consumer products. What is the *latest* fashion in sportswear? What are the consumer reports on that *new* truck model? Isn't it time to buy a *new* suit...? In marketing consumer goods, "new" is good and "old" or "used" is considered bad. Manufacturers will make slight changes in their product to allow them to promote the "new and improved" product. Even a change in packaging will be heralded by an advertising campaign to promote the "new look."

Not only do consumers favor new products, they also favor the convenience of disposable products. Disposable drinking cups, paper towels, diapers – they are used once and then thrown away. This type of consumer behavior is heavily promoted in our society. The demand for consumer goods is an important stimulus to our manufacturing industry as well as the primary resource industries. Trees are harvested for paper and wood, oil is processed for chemicals and plastics, and ore is mined for steel and aluminum production. Many of these natural resources are non-renewable, so it is important to use them wisely and extend their utility into the future. Renewable resources, such as our forests, are renewable only if they are not consumed more rapidly than they are replaced.

Another consequence of our consumer lifestyle is the proliferation of solid waste. "Scrap," "garbage," "trash," "refuse" – whatever it is called, we generate large amounts of it and the volume is growing. Disposable items, excessive packaging, and short-lived products contribute unnecessarily to this proliferation. Free (1985) estimates that each Albertan generates almost 800 kg of solid waste each year. Although we seldom think about solid waste management, considerable time, energy, and money are devoted to waste collection and disposal. Without proper management, this solid waste can be unhealthy, unsightly, and harmful to the environment.

Not only can solid waste cause materials management and environmental problems, it also represents a missed opportunity. Much of the waste material being buried in landfills has value. Paper, glass, metal, oil, plastics, rubber, and other materials can often be reused, sometimes in their original form, but also as secondary material for remanufacture. Other valuable uses of solid waste include its conversion to fuel for energy production or compost for soil conditioning. We are wasting more than material resources; we are wasting opportunities!

Over the past couple of decades, an awareness of the need to conserve our natural resources has been growing. In 1972, the Club of Rome published its controversial report, *The Limits to Growth*, which contained many dire predictions about impending shortages of natural resources (Meadows and Meadows 1972). The Science Council of Canada has discussed the important role of conservation for our nation (Science Council of Canada 1977).

Many other studies have been published to illustrate the need for conservation and, in 1980, a World Conservation Strategy* was produced. Recycling of waste material is an important component of this conservation strategy.

In this report, public attitudes towards recycling and the costs and benefits to our society will be examined. A selection of recycling activities being conducted in Alberta will be discussed.

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*The World Conservation Strategy was produced under the auspices of the United Nations Environment Program, the World Wildlife Fund, and the International Union for Conservation of Nature and Natural Resources.

2. THE NATURE OF RECYCLING

"Recycling," "reuse," "recovery" – these are terms commonly used to describe the retrieval of useful material from the waste stream. The Random House Dictionary definition of "recycle" is "to treat or process (used or waste materials) by making them suitable for reuse."

There are four basic ways to recycle consumer products:

- Reuse of a product for its original purpose. Examples of this include clothing handed down to younger family members, used cars, and refillable beverage containers. This form of recycling extends the life of the product and therefore defers its ultimate disposal and the demand for a replacement. This method is often practised within the household; however, community service groups, private companies, and government organizations are also involved through the collection of used clothing, sale of used cars, collection of refillable bottles, and so on.

- Reuse of a product in its original form for a new purpose. Some people reuse cardboard boxes for storage, glass jars for storing nuts and bolts, and grocery bags for kitchen scraps. This kind of recycling also defers ultimate disposal of the product and the demand for other consumer goods (for example, special storage containers). It is practised primarily within households, offices, and commercial establishments.

- Reuse of material for remanufacture of the same material. The material from some products can be reused to make new material. For example, scrap metal from tin cans, automobile bodies, and other products can be used as a raw material in the production of new steel. Aluminum cans can be used to make new aluminum, newspaper can be de-inked and re-pulped to make new paper, and cullet (broken glass) can be used in the production of new glass. This form of recycling is practised by private industry, although other segments of society may be involved by supplying recyclable material to the manufacturer.

- Reuse of the material for a new purpose. Waste paper can be used to produce insulation, building materials, animal bedding, and other products. Glass bottles can be crushed and made into beads for sandblasting or added to reflective highway paints. Plastic beverage containers can be shredded and used as an insulating filler for winter clothing. Mixed material from municipal solid waste can also be processed into useful products. The organic component of municipal solid waste can be processed into compost, a soil-conditioning agent. Pyrolysis,

or destructive distillation, of the organics can produce a variety of useful chemicals and solid char. Mixed refuse can also be incinerated to produce heat energy for domestic or industrial applications. These methods of recycling form the basis of a secondary materials industry.

THE ROLE OF PUBLIC ATTITUDES

Although the above four ways of recycling material presently occur, there appears to be a great potential for expansion of these beneficial activities. What is holding us back? Many factors affect recycling in our society. Markets for waste materials can be highly variable. The design of consumer products can make recycling difficult. For example, it may be difficult to segregate a product containing several materials into recyclable components. Because recycling often relies on the public to contribute recyclable materials and to purchase recycled goods, public attitudes towards recycling also have an important influence.

Attitude

People don't like solid waste. Even the terms used to describe it have negative connotations – garbage, refuse, trash, scrap, rubble, litter, junk, debris, waste, and so on. Most people would rather have as little to do with their waste as possible; they prefer it out of sight and out of mind. Negative attitudes are particularly strong against *other* peoples' waste. Bealer et al. (1982) cites several examples of American communities that have passed up economic benefits primarily because of community attitude towards waste. For example, a Pennsylvania township rejected a plan to fill a dangerous and unsightly strip mine with baled refuse from Philadelphia and finally reclaim it for recreational and other benefits. Although reclamation of the abandoned mine was positive and beneficial, they didn't want to become known as "the garbage spot of Pennsylvania."

Negative community attitudes towards waste are evident in Alberta as well. Municipalities often face stiff opposition from local residents when trying to select landfill sites for municipal solid waste. The City of Edmonton, for example, has been confronted with local opposition to a proposed expansion of the Cloverbar landfill site. Residents near Lacombe challenged the regional landfill proposed for that area. Reasons for local opposition vary, but they generally focus on anticipated problems, such as general unattractiveness, blowing litter, increased truck traffic, odor, and reduced property values. Modern sanitary landfills, however, are designed to reduce these problems. Indeed, some studies have found that local residents are less hostile towards *operating* landfills than they are towards *proposed* landfills; the annoyances are often less than anticipated (Bealer et al. 1982).

Negative public attitudes that inhibit recycling activity are not restricted to those towards solid waste. They are also reflected in attitudes towards used products and materials. Consumers usually show a preference for new goods over used goods and this produces an additional hurdle in the marketing of recycled goods and materials. Product designs sometimes specify that only new materials be used, when in fact that requirement may be unnecessary. Consumers may be reluctant to purchase products that contain recycled material, even though the quality and durability is equal to that of products made from virgin materials. For example, the lubricating properties of recycled oil are the same and perhaps better than virgin oils; in fact, re-refined oil is favored by some industrial users (Kennedy 1978). General public acceptance, however, is developing very slowly.

Public attitudes towards the concept of recycling are much more positive. Most people support recycling. Public opinion surveys in two American communities revealed few of the residents (up to 3 percent) had a negative attitude towards recycling (*Resource Recycling* 1982). In fact, "...resource conservation, recycling, and associated principles and practices have very much become 'motherhood' issues" (F.C. Haussmann Consulting 1979: iii). With such a positive attitude, why don't more people recycle?

For many years, social psychologists considered attitude to be a key factor determining a person's behavior. Attitude is how people feel about a subject and behavior is how they act. Positive correlations between attitude and behavior are often observed. However, some studies have shown a lack of correlation between expressed attitude and overt behavior, and now the significance of attitude is a subject of controversy (Nielsen and Ellington 1983; Weigel 1983). Other factors affect behavior and can produce behavior that is inconsistent with attitude. Personal factors, such as motivational state, intelligence, disposition towards other aspects of the situation, knowledge of appropriate behavior, as well as situational factors such as expectations of others present, convenience, social norms regarding appropriate behavior, probable consequences, and many other factors come into play (Weigel 1983). People may express a certain attitude but may not be sufficiently motivated to act accordingly. Thus, a favorable attitude towards recycling does not necessarily translate into recycling action.

Why Do People Recycle?

For those people who do recycle, what is their motivation? Many reasons are offered in support of recycling, including conservation of natural resources, reduced pollution, personal monetary gain, support for a charitable group, and compliance with regulations. Conservation of natural resources is often cited as the principal reason for recycling. Resource conservation, including conservation of materials and energy, was offered as the primary reason for recycling by a majority of respondents in a recent Oregon survey (Oregon Department of Environmental Quality 1985). Ninety-two percent of the respondents to a Quebec survey about beverage container recycling indicated that they thought that the recovery of all beer and soft drink containers is an important step in the conservation of raw materials (SECOR 1984). In a survey of residents in the northwest United States and British Columbia, about 75 percent of the respondents felt that recycling is important to the conservation of natural resources and preservation of the environment (Intercept Research Corporation and Brian Gard Inc. 1984).

Charitable benefits are also offered as a reason for recycling. In Vancouver, a strong majority of survey respondents expressed a willingness to save newspapers for a local charitable group or to help conserve natural resources (Intercept Research Corporation and Brian Gard Inc. 1984). Most of the respondents expressed unwillingness to save newspapers for only personal monetary gain. Seventy percent of recyclers in a California poll participated in charitable recycling programs while only 12 percent received money for their contributions (*Resource Recycling* 1982). Thus there appears to be a degree of altruism in recycling; people will do it for perceived benefits to others or to society in general rather than for personal gain.

Numerous surveys have shown that an economic reward or reduction in personal costs have only a moderate influence on a person's decision to recycle (*Resource Recycling*

1982). In a survey in Seattle, Washington, "receiving payment" was the least popular of eight reasons for recycling. Only one-quarter of the respondents indicated that such a reward was a consideration in their recycling behavior (*Resource Recycling* 1982). A nationwide telephone survey in the United States indicated that one-half of those interviewed would be willing to return their waste lubricating oil to a recycling depot, but offers of payment for the oil did not affect their willingness (*Resource Recycling* 1982).

Many people do not recycle. Factors related to convenience are the most frequently reported obstacles to participation. A large number of non-recyclers in Vancouver found that recycling was simply "too much hassle" (Intercept Research Corporation and Brian Gard Inc. 1984). In the 1984 Oregon survey, 74 percent of the respondents indicated convenience factors as the greatest obstacles to recycling (Oregon Department of Environmental Quality 1985). Many claimed that it took too much time and that people were just too lazy to recycle. A review of two dozen opinion polls revealed "insufficient storage space" as the most common reason for not recycling (*Resource Recycling* 1982). In a discussion about waste paper recycling, Humphrey et al. (1978-79) found that the problem of storage space had affected participation in a number of paper recycling programs.

Motivating People to Recycle More

From the above discussion, it appears that a simple increase in convenience can increase recycling activity. Where collection bins or depots are used, convenient location has been shown to improve participation. For example, 83 percent of the non-recyclers in Vancouver would use newspaper depots if conveniently located, and most of them expressed willingness to travel up to 5 miles (8 km) to a recycling depot (Intercept Research Corporation and Brian Gard Inc. 1984). In an experimental program for recycling beverage containers in college dormitories, increasing the number of receptacles improved the response of the students (Luyben et al. 1979-80). Door-to-door collection is another means of increasing convenience and recycling rates.

A more active role in motivating people is also possible. In his discussion about the use of incentives to motivate people to recycle, De Young (1984) describes extrinsic and intrinsic incentives. Extrinsic incentives are those offering an individual some external reward, whether it is monetary gain, increased comfort, or social approval. Although extrinsic incentives are generally effective at increasing recycling behavior, they do have drawbacks. If the reward is larger than the value of the material collected, the cost effectiveness of the program will be unfavorable. A more serious problem is that once the incentive is removed, recycling behavior tends to drop to its previous level.

Intrinsic incentives have not received as much attention and are not as well understood. De Young (1984) describes an intrinsically motivated activity as "worthwhile in its own right." Some people derive satisfaction from performing worthwhile tasks in the absence of an external reward. De Young (1984) suggests that the motivation to recycle has a major intrinsic component for most people and that this has not been given adequate consideration by promoters of recycling projects. The importance of intrinsic motivation appears to be supported by the results of public surveys of recycling behavior.

The effectiveness of methods for motivating people to recycle has been studied by sociologists and psychologists. Common methods include simple prompts, raffles, contests,

and cash refunds. Prompts take the form of signs or flyers encouraging recycling, direct requests to recycle, or simply the presence of a collection container. Prompts generally have a small, but consistent, positive effect on recycling behavior (Cone and Hayes 1977). Although prompts can play an important role in a recycling program, the small size of the benefit derived has serious implications for programs that rely *entirely* upon education programs to encourage recycling (Cone and Hayes 1980). Additional motivational techniques should be considered.

Incentives that reinforce recycling behavior, such as contests among groups contributing recyclables or raffle tickets given for recyclable material, can induce higher recovery rates than simple prompting (Humphrey et al. 1978-79; Cone and Hayes 1977). Such programs may be effective with target groups or some segments of society, but they may not be suitable for an entire population. Direct monetary incentives may have more general appeal. The deposit-refund system for refillable bottles or paying cash for newspapers at buy-back centers are examples of this. Experience has shown that such monetary incentives can increase recycling rates substantially, even though respondents to opinion surveys usually underrate this motivation. Cash refunds stimulate both charitable drives and personal returns.

SOCIAL COSTS AND BENEFITS OF RECYCLING

Recycling does not always benefit an individual directly. However, benefits accrue to society in general and hence to the individual indirectly. Recycling affects waste management costs, conserves natural resources, generates employment and industrial activity, and creates income for special groups and individuals.

By reducing the amount of waste material requiring collection and disposal, recycling can reduce collection costs and extend the operating life of a landfill. A multimaterial recycling program in Kitchener, Ontario diverted 11.8 percent of the city's solid waste during the first quarter of 1984 (Kairow 1984). In Kanata, Ontario, a paper recycling program has reduced the number of trips to the landfill site by waste collection vehicles (OECD 1983). Other studies confirm a substantial reduction in solid waste as a result of recycling projects. Where waste is collected by municipal workers, this translates into savings for the taxpayer. Where collection services are paid for by the waste generators, such as commercial and industrial establishments, savings can benefit consumers.

Estimating the magnitude of potential savings is a complex matter. Indeed, some costs may increase. Refuse that is segregated into separate components may require more complex storage, handling, and transportation than mixed refuse. Special compartmentalized vehicles may be necessary for collection of segregated materials. If the recyclables are delivered to a local depot by the resident rather than through community collection, a saving in municipal waste collection costs would be expected. However, these costs are then transferred to the individual. Revenues from the sale of recycled material will help to offset some waste management costs. However, it is difficult to determine whether this complex array of financial costs and savings balances out. (For more information on the economics of this and other aspects of recycling, see the Environment Council report *Economic Barriers to Recycling* by C. Webb.)

Looking beyond waste management, recycling has implications for resource conservation and environmental protection. By substituting secondary (recycled) materials for virgin materials in manufacturing, natural resources are conserved. This can be illustrated by the use of waste paper in paper production or the re-refining of waste oil. In these examples, the respective demand for trees and for crude oil is diminished. Glass production can incorporate large amounts of cullet (broken glass) with a saving of 1.2 tonnes of raw materials for every tonne of cullet used (OECD 1983).

The requirements for other resources, such as energy, are sometimes reduced if secondary materials are used. For example, less energy and process water are needed for paper production if recycled fiber is used (OECD 1983). Similarly, for glass manufacturing, there is a 2 percent saving in energy for every 10 percent of cullet used as a raw material. More impressive energy savings occur in aluminum production. It takes 20 times less energy to produce aluminum from scrap than from bauxite ore (Chandler 1983).

Cone and Hayes (1980) warn, however, that "...the term 'recycling' should not be taken as a process that is, a priori, always and everywhere environmentally desirable" (p. 130). They point out that while the manufacture of low-grade paper produces less waste if recycled fiber is used, the manufacture of high-grade paper with recycled fiber produces *more* solid waste than if virgin raw material is used. De-inking newsprint before reuse can produce pollution if proper precautions are not taken. They also express concern that small-scale recycling programs may consume more energy than is conserved (Cone and Hayes 1977). Consequently, care must be taken to ensure that recycling and the utilization of secondary materials maintain high standards of production efficiency and pollution control.

Many recycling programs provide additional social benefits by generating revenues for local charities. Community service clubs such as the Boy Scouts, schools, and church groups are frequently involved in paper or bottle drives to raise funds. In addition, many rehabilitation centers operate bottle or paper recycling depots. This provides training for disadvantaged individuals who may not have the opportunity to contribute to society through their labor in other types of industries. In Alberta, where there is a deposit-refund system for beverage containers, the collection of discarded beverage containers provides an important source of personal income for some individuals, such as the urban "street people" (Gravelines 1985). This income can give them a sense of independence and worth by reducing their dependence on social assistance. These people also provide a useful community service by cleaning up discarded bottles and cans.

Recycling also influences society's commerce and industry. The use of secondary materials in manufacturing competes with the primary materials industry. This may result in a shift of employment opportunities, but not necessarily in a net loss in jobs. Indeed, the recycling and secondary materials industries have potential for economic growth and job creation.

Recycled materials are valuable commodities that are traded interprovincially and internationally. Alberta's steel industry is based entirely on scrap metal, much of which must be imported. Increased recycling of ferrous metal in Alberta would therefore benefit local steel industries. Alberta currently exports its used aluminum cans and plastic soft drink bottles, although some interest in establishing a plastics industry based on plastic soft drink containers has recently been shown (Strategic Development Services Ltd. 1985). Other waste materials also offer opportunities for innovative exploitation.

3. RECYCLING IN ALBERTA

Recycling in Alberta involves many different sectors of our society, such as individuals, community groups, private businesses, and government organizations. Some recycling is an unnoticed part of personal lifestyles. Many people reuse boxes, jars, and bottles for storage of household items. Kitchen scraps are often fed to pets or farm animals or added to compost piles along with grass clippings and other yard waste. Clothing is often handed down to younger family members or cut up into rags for cleaning.

Many recycling projects, however, are organized at the community level. Most Albertans have participated in community bottle or paper drives. Such projects may involve several sectors of society. For example, a project may be sponsored by a charitable group, and aided by government funding, with the collected material being sold to a private business. Naturally, all recycling projects rely on the participation of individuals. In this chapter the nature of recycling projects will be examined, with examples from Alberta's experience.

WHAT MATERIALS ARE RECYCLED?

Although recycling activities apply to a multitude of materials, only a few materials support secondary materials industries in Alberta. These include recycling beverage containers, paper products, lubricating oil, scrap metal, and textiles. Detailed descriptions of Alberta's recycling industries are presented in Lilley (1985) and Strategic Development Services Ltd. (1985).

In 1971, the Beverage Container Act established the current mandatory deposit-refund system for beverage containers in Alberta. This system was primarily intended to reduce the litter that these products contributed to the Alberta landscape and has been quite successful in that respect. It has also stimulated the development of a widespread system of depots for collecting beverage containers. All soft drink bottles and cans, liquor and wine bottles, and imported beer containers qualify for refunds under the Beverage Container Regulation (AR 320/78). An amendment in 1980 added single-serving fruit and vegetable juice cans to this list. As well, domestic beer containers can be returned to these depots, directly to the breweries, or to Alberta Brewers' Agents' depots.

As a result of this deposit-refund system, large quantities of beverage containers are recovered in Alberta. Refillable glass containers are returned to the bottling companies to be washed and reused. Non-refillable glass containers are crushed and used in the manufacture of new glass products. Recovered aluminum cans are exported to aluminum smelters and plastic soft drink bottles have been shipped to the United States to be shredded and used to make fiberfill stuffing. Sometimes, however, the supply of recovered containers exceeds the demand and the surplus must be landfilled.

A recycling industry has also developed around the collection and reuse of waste paper. This includes many different grades of paper including newsprint, corrugated cardboard, ledger, computer printout, and others. Unlike the beverage container system, collection of used paper is directed entirely by the private sector and the price fluctuates with market demand.

There are four companies in Alberta involved in the acquisition of waste paper (Strategic Development Services Ltd. 1985). The paper is used for the production of various building products, such as fiberboard, tarpaper, shingles, insulation, and others. Shredded paper is sold for packaging and animal bedding. Waste paper is also exported from Alberta to other provinces and countries.

Another material that is recycled commercially is used lubricating oil. In the past, waste oil was collected primarily from large commercial users, such as railway companies. Recent increases in the price of oil have attracted other sources. With the encouragement of Alberta Environment through its "Oil Drop" program, motor oil is being collected at gas stations and recycling depots around the province. Several companies are involved in purchasing waste oil and selling it to Alberta's two re-refining facilities.

Scrap metal is an important recyclable material and there are many scrap metal dealers in the province. Alberta's steel industry relies entirely on scrap metal. Non-ferrous metals, such as copper, zinc, silver, and others, are also recovered, primarily from industrial sources. Beverage cans constitute a growing source of aluminum scrap. However, there are no aluminum smelters in Alberta; aluminum scrap is exported from the province.

Another commercially recycled commodity is clothing and textiles. Several charitable organizations, such as the Salvation Army, Goodwill Services, and Interfaith, receive donations of used clothing. Most of the clothing is resold, and clothing that is not suitable for wear is sold to companies that make it into cleaning rags.

COLLECTION OF RECYCLABLES

Two basic strategies are employed for the recovery of recyclable materials from the solid waste stream: collection of separate recyclable materials (at-source separation) and processing mixed refuse to recover recyclable material. Most recycling schemes rely on at-source separation, although advances are being made in processing mixed refuse. At-source separation is often desirable because the quality of the recovered material is more easily maintained. Once mixed with other waste, some materials become contaminated and difficult to isolate. By separating the valued material at the point of generation, this problem can be avoided. However, it requires special effort by individual waste generators to segregate their waste into the desired components, such as paper, glass, or metal, and other refuse. The materials must also be stored separately until they can be collected.

Collection methods vary according to the nature of the recyclable material and the nature of the targeted sources, as well as the experience and resources available to the collectors. Many forms of gathering recyclable materials are used, including drives, supervised depots, collection bins, pick-up, and others. A discussion of their advantages and disadvantages follows.

Drives

Newspaper and bottle drives are common in Alberta communities. They are usually sponsored by local service groups or charitable organizations. The sponsoring group promotes the drive by word-of-mouth, distributing flyers, putting up posters, advertising in community newspapers, and other methods. On the day of the drive, members or supporters of the sponsoring group conduct door-to-door collection of the recyclables. Arrangements are made to deliver the donated material to the purchasing company.

These drives constitute an important source of materials for the purchasing companies and there is a certain amount of competition to get this supply. Many of these companies provide assistance to the sponsoring group. This involvement also allows the company to explain what materials are acceptable and how they should be prepared for delivery. For example, sorting the material according to certain categories may fetch a higher price. Many of Alberta's bottle depots offer advice to groups wishing to conduct bottle drives. These depots may supply boxes for the collection, or a truck to pick up the collected bottles. Companies that buy waste paper often provide collection bins for paper drives and will pick up the paper following the drive. The company may charge the sponsoring group for the use of a collection bin and transportation charges may be contingent upon the amount of paper collected.

As a result of Alberta's mandatory deposit-refund system for beverage containers, the purchase of the collected bottles and cans is guaranteed at established prices. Newspaper collection, on the other hand, is much more sensitive to the vagaries of the marketplace. When the market for waste paper is weak and prices are low, companies that normally purchase paper from charitable drives may be unwilling to buy the waste paper. Sponsoring groups can be left with a truckload of valueless newspaper if they did not pre-arrange a firm deal. On the other hand, when the market is strong, waste paper can provide a good source of revenue to the group.

Community support for paper and bottle drives is usually quite good. A successful drive can collect a large amount of material in a relatively short time. This benefits both the fund-raising group and the purchasing company. Furthermore, this system of collection is very convenient for contributing residents. The people who donate material to the drive are only required to save their newspapers or bottles and remember to have them available for collection on the designated day. This offers them an easy way to get rid of some "waste" material while contributing to a worthy cause.

The sponsoring group relies heavily upon volunteers to do much of the advertising, collecting, sorting, and delivery of the material to a depot or other purchaser. Motivation of these volunteers is crucial for a successful campaign. Because so many people are involved, many of whom are inexperienced, organization is very important and sometimes difficult. Tasks must be assigned, collection routes planned, and so on. Promotion of the upcoming collection is necessary to ensure adequate participation rates in the community.

If drives occur regularly, residents develop a habit of saving their recyclables in anticipation of future drives. However, because drives are run on an ad hoc basis and may be sponsored by different community groups, they tend to be irregular. Drives usually depend

upon the concerted effort of a few dedicated individuals and over time their enthusiasm and involvement may diminish. Fund-raising activities for the group can change as different people get involved and this can lead to an end to the familiar "collection service." Residents who have saved newspapers or bottles in anticipation of future drives may find themselves burdened with a stockpile that has to be delivered personally to a depot or discarded as refuse. This can reduce their willingness to participate in future drives.

Many Alberta groups have used paper or bottle drives to generate revenue to support their activities. Bottle drives have been an important source of revenue for the Boy Scouts for many years. Fund raising in this organization is largely determined by individual scouting groups and many troops around the province conduct bottle drives on a regular basis. Each drive can bring in several hundred dollars. Although bottle drives are usually favored, some scouting groups are involved in paper drives as well.

The Girl Guides also raise funds through bottle and paper drives. In Spruce Grove, Alberta, the Guides have organized a monthly collection of old newspapers to raise money for a trip to Holland. These drives raise an average of $150 to $200 per month. Community support has been very good and the group will likely continue this fund-raising activity. Girl Guides also collect newspapers in St. Albert.

Many other groups, such as church youth groups, school bands, sports teams, and similar organizations conduct drives in communities around the province. These drives are often associated with special projects, such as a trip or the purchase of a special piece of equipment. In some communities, several groups may raise funds through paper or bottle drives. Sometimes there is informal coordination among the sponsoring groups so that competition and overlap is reduced. For example, if it is generally known that the Boy Scouts conduct regular bottle drives in a community, other groups might respect the Scouts' "monopoly" and seek other ways to raise funds. However, this informal coordination is not always effective. Some communities may have several groups conducting drives within a short period of time and the resulting competition can reduce their individual successes. However, in communities where only one or two groups raise funds in this manner, drives can be very successful.

Depots

Many kinds of recycling depots are found in Alberta, ranging from unsupervised collection bins to supervised buy-back centers. Collection bins are commonly used for paper, glass, and sometimes clothing, with the materials or revenues going to a charitable group or project. These bins are usually placed at central locations, such as shopping malls, schools, churches, or community centers. Apartment buildings or other high-density residential areas may also warrant collection bins. As the presence of these depots becomes known, residents and shoppers can contribute material to the recycling projects.

There are several advantages to this method of collection. The bins are durable and can usually hold a large quantity of material, thus requiring infrequent emptying or removal. No supervision is required and contributors can deposit their material at any time. If the location is also visited regularly for other purposes, such as shopping or worship, people can deliver goods to the depot in conjunction with these other tasks. Thus, recycling is made convenient.

In order to improve the recycling rate, area residents can be encouraged to use these bins. If the recycling project benefits a charitable group, this fact can be advertised on a sign or on the bin itself. The sponsoring group may also promote the depot by distributing flyers or by other advertising means. Long-term collection using unsupervised bins can be supplemented by special drives.

Collection bins have certain disadvantages, as well. Because they are unsupervised, they may be subject to vandalism, arson, or theft. This can result in additional maintenance costs and loss of valuable donations. If the bins serve a small population or are used only by a few committed people, it may take a long time before the bin is sufficiently full to warrant emptying. Promotion of the recycling program may require a sustained effort.

In Alberta, several companies promote newspaper collection using collection bins (Strategic Development Services Ltd. 1985). Some bins are left for a long period at one location, while others are provided for specific paper drives. The Variety Club of Northern Alberta, the Alberta Association for the Dependent Handicapped, and local rehabilitation or vocational training centers are examples of organizations that sponsor or own paper bins. Many of the Co-op Stores in the Calgary area have collection bins for newspaper and contribute the revenues to charitable organizations. Some bottle depots have paper bins and will buy waste newspaper from the general public.

Collection bins can also be used to collect other material, such as glass and scrap metal. Several Alberta rehabilitation centers collect clear (flint) glass, such as food jars and non-deposit bottles, in this manner. The glass is crushed and sold to a glass manufacturer in Redcliff, Alberta. Interfaith Thrift Stores in Calgary use collection bins for second-hand clothing in addition to their pick-up service. Vandalism and theft from the bins is a problem, but not enough to discourage the use of these receptacles. Goodwill Rehabilitation Services of Alberta discontinued their use of collection bins for clothing several years ago because problems developed with transients sleeping in these bins. Cigarette smoking has, on occasion, started fires causing damage and serious injuries.

Supervised depots are an alternative to collection bins. They are supervised by volunteers, special trainees, or paid employees. These depots have specific hours of operation and can also serve as buy-back centers, where people can exchange recyclables for cash or other forms of compensation. At some depots in the United States, coupons for store merchandise are issued rather than cash.

Most of Alberta's bottle depots are operated as profit-making businesses. Some, however, also serve as special workshops for mentally or physically disabled adults. At least a dozen vocational rehabilitation centers in Alberta operate some sort of recycling depot. A majority of these rehabilitation centers collect newspaper and some collect several grades of paper. Paper is gathered using unsupervised collection bins, pick-up with trucks, or may be brought in to the center by contributing citizens. Several rehabilitation centers operate licenced bottle depots and collect a full range of beverage containers. Glass containers that are not included in the deposit-refund system, such as food jars and bottles, are accepted at some rehabilitation centers, where they are sorted and crushed for sale to a glass manufacturer. Used clothing is collected for resale or conversion into cleaning rags.

Most of the rehabilitation centers generate small revenues from their recycling activities. However, these activities do provide valuable training experience for disabled adults. The trainees may be involved in several tasks, such as accepting material from the public, sorting the material, operating machinery, and packaging a final product. Although most of the rehabilitation centers sell the material to companies in the secondary materials business, some manufacture their own useful products. Paper is shredded and packaged for use as animal bedding or packaging material. At one rehabilitation center, newspaper is folded and sold to florist shops, where it is used to wrap flowers. In Grande Prairie, a rehabilitation center gets sawdust from the local mill, processes it, and packages it as "rig sawdust" to be mixed with drilling mud used in oil and gas exploration. A great deal of innovation is evident in these organizations.

Other groups have operated supervised depots as well. Back in the mid-seventies, the Boy Scouts operated a bottle depot in central Calgary. This short-lived operation did not make a profit for the group and there were problems in supervising this business operation. Would such a venture succeed under today's conditions?

One problem faced by people who use either supervised or unsupervised depots is that of storage of the material until enough has accumulated to warrant delivery to the depot. In a review of public opinion surveys on recycling, insufficient storage space was found to be the most frequently cited reason for not recycling (*Resource Recycling* 1982). The frequency of delivery by an individual is self-determined, and so a person can reduce this problem by more frequent trips to the depot. However, this reduces the convenience of this system.

A new approach to the recovery of recyclable beverage containers is the reverse vending machine, a kind of automated depot. Several companies have developed these vending machines, into which consumers place empty beverage containers. The machines scan the item and refund money and/or coupons for merchandise if the container is accepted. The initial target of this machine was the aluminum can, although some machines are available that accept glass and plastic soft drink bottles. Some machines accept containers in bulk, whereas others must be fed one container at a time. These machines have enjoyed initial success in the United States and the technology is still improving (Goldstein 1984).

Curbside Collection

If waste generators segregate their waste into designated categories, such as paper, metal, plastic, and so on, large quantities of recyclable materials can be collected. Curbside collection of recyclable materials can be conducted in conjunction with regular waste collection. Collection vehicles can be designed with separate compartments for the different materials. Existing single compartment collection vehicles can be modified with special bins, racks, trailers, and so on to accommodate separate collection. Alternatively, another vehicle can follow the collection route and pick up only the recyclable material. The recyclable material can be delivered to a central depot for processing or storage. Other waste material is directed to disposal facilities.

The separate collection of certain waste materials is not an uncommon practice. Powell (1984) estimates that there are about 500 communities in the United States and

Canada with curbside collection recycling service. A common practice is to collect newspapers separately from other waste. There are six curbside newspaper collection programs in the Greater Vancouver Regional District and more are anticipated (Recycling Council of Ontario 1985). In several Calgary neighborhoods, Foothills Conservation and Recycling Ltd. operates a regular newspaper collection service under the sponsorship of charitable groups. Although the sponsoring group does not participate in the actual drive, it is paid a royalty for the paper collected. In Toronto, weekly curbside collection of bundled newspapers has been conducted by the City since 1972. A pilot project has been initiated to expand this Toronto program to include glass and cans. Initial results indicate that collection of newspaper has improved and that the recovery of glass and cans is better than through the existing depot system (Kairow 1984). The City of Oshawa is also experimenting with an expansion of their curbside newspaper collection to include glass and cans (Recycling Council of Ontario 1985).

Multi-material curbside collection is gaining prominence. In Fredericton, New Brunswick, a system of curbside collection was initiated in a small area in 1980 and has continued to expand to other parts of the city (Carson 1984). This program is operated by a non-profit organization in conjunction with the Fredericton Training Center of the Canadian Association of the Mentally Retarded. Several materials are collected, including paper, glass, metal, and plastic. The collected recyclables are sorted by the handicapped trainees.

Many communities in southern Ontario, including Niagara Falls, Burlington, Whitby, and several others, offer multi-material curbside collection either as an on-going service or as a pilot project. Total Recycling Systems Ltd., a division of Laidlaw Waste Systems Ltd., operates a very successful curbside collection in Kitchener. Every single-family dwelling has been issued a blue plastic box to hold recyclable items. On the regular garbage collection day, residents are asked to set these boxes out at curbside for collection by a special collection vehicle. Bottles and cans are placed mixed in the box with bundled newspapers on top. Used motor oil has been added to the collection service and is placed beside the box in plastic jugs. Participation has been very encouraging, with rates as high as 80 percent in some neighborhoods (Ludolph 1984). The collection of grass clippings for composting is being tested in a pilot project.

In May, 1976, Alberta Environment initiated a year-long experiment in multi-material curbside collection in Drayton Valley. Householders were asked to segregate their newspaper, glass, and metal waste for collection. At its peak, 140 households (out of a possible 1,700) participated in this project. After several months, newspaper collection was transferred to the Boy Scouts. Only about 1,000 lbs. (454 kg) each of glass and metal were collected over the life of the project. A subsequent evaluation of this project suggested that it suffered from insufficient advertising (Alberta Environment 1978). It was suggested that sponsorship or promotion of the project by a local community group, rather than an outside government agency, would have improved community participation (Alberta Environment 1978).

In many curbside collection programs, residents are supplied with a special container to hold the recyclable materials. For example, plastic bags are provided for newspapers in Vancouver and Calgary. Several programs in the Niagara region of southern Ontario provide wire baskets to hold bottles, cans, and papers. Plastic recycling boxes, such as those offered in Kitchener, are also popular. A common feature of these containers is their conspicuous

appearance. They are usually brightly colored and display a prominent slogan, such as "WE RECYCLE." This reinforces the purpose of waste segregation and advertises the participation of residents in the program. On collection days, it is easy to identify participating households and thus facilitate the influence of community peer pressure.

Although the provision of these containers adds to the expense of the collection system, experience has shown that it increases the quantity of material collected. In the city of Toronto, plastic storage containers were provided on a trial basis in two areas that had curbside collection of recyclables. Participation increased by 10 and 20 percent respectively, with a dramatic increase in the quantities recovered (Kairow 1984).

Local legislation is another strategy that can be used to increase participation in curbside collection of recyclables. A 1981 survey by the Environmental Protection Agency (EPA) reported 52 American communities with mandatory recycling ordinances (Cooper 1982). It concluded that such ordinances usually lead to a 30 percent increase in recovered materials. In Islip, New York, approximately 20 percent of the solid waste is diverted as a result of a mandatory segregation ordinance (Hertzberg 1983).

Studies have shown that higher participation rates are more likely with mandatory waste segregation than with voluntary programs (Nielsen and Ellington 1983). In a 1979 survey by the U.S. EPA, 59 percent of the mandatory programs had participation rates of 50 percent or more, while only 19 percent of the voluntary programs could make this claim (Cooper 1982). In Fredericton, New Brunswick, operators of the curbside collection program anticipate the introduction of mandatory segregation legislation if 50 percent or better participation can be achieved with the voluntary program, thus showing strong community support (Carson 1984). They expect that such legislation would boost participation even further.

Mandatory waste segregation ordinances usually define the recyclable materials, describe how they are to be prepared, and explain when and where they are to be set out for collection. Common provisions for enforcement include fines, warning stickers on refuse containers, and refusal to collect the unsorted waste (Seldman and Ferrand 1982). However, these ordinances are not always enforced. In a survey of 28 American communities that have such ordinances, only half enforced them (Cooper 1982). Satisfactory participation rates can usually be achieved without resorting to enforcement measures. Most residents will comply with regulations that are reasonable and well publicized.

"Piracy" of recyclables that have been set out for collection can pose a problem if not controlled. Residents often place their recyclables at curbside the evening before collection. Pirates can collect the material late at night when few people are up and about. In Burnaby, B.C., paper pirates have been picking up three times as much paper as the official crews (Leung 1985). In some jurisdictions, anti-scavenging legislation has been introduced to curb this problem. Such ordinances prohibit unauthorized persons from picking up recyclables that have been set out for collection and specify fines or other penalties.

Mixed Collection

In addition to material recovery using separate collection, there is also the potential for resource recovery from mixed waste. Mixed refuse can be processed at a central facility

to recover materials or produce certain products. Many technologies and procedures are available to sort the refuse into different components: shredding, magnetic separation, air classification, screens, sorting by hand, and others. Some materials can be recovered through this mass processing without too much difficulty. However, other materials are difficult to isolate from mixed refuse. Recovered materials often require upgrading before they attain the desired quality or they are only useful in low-grade applications.

The large-scale processing of mixed refuse is well suited to the production of heterogeneous products, such as compost or solid fuel. Initial preparation of refuse for fuel usually consists of shredding or grinding and removal of non-incinerable material, such as metal and glass. The refuse can be fed into incinerators as a loose fuel or it can be pelletized to facilitate handling. The production of refuse-derived fuel is gaining prominence in the United States and Europe. Bird and Hale et al. (1979) estimated the heat value of municipal solid waste from Alberta at about 18,470 kJ/kg (7946 BTU/lb), which is comparable to Alberta Plains Coal.

Although recovery of some materials (for example, non-incinerables) is compatible with the incineration of refuse to produce energy, there may be competition between incineration and the recycling of other materials. For example, municipal solid waste is generally 30 to 50 percent paper by weight (Free 1985). An efficient paper recycling program would therefore reduce the quantity of refuse available to an energy-from-waste (EFW) facility. On the other hand, the energy value of the remaining refuse might be enhanced, primarily because of the relative increase in the proportion of high-energy plastics in the waste material.

The concern about competition for waste material has led some jurisdictions to discourage recycling. In Dade County, Florida, which is served by an EFW plant, an ordinance forbids the export of newsprint for recycling (Seldman and Ferrand 1982). Other communities have required that waste haulers deliver all of their material to an EFW plant. Allowances for diversion of a small amount of material for recycling have sometimes been made (Seldman and Ferrand 1982).

For EFW facilities, one solution to the problem of competition for waste might be to design the incinerators with smaller capacities, which would allow for diversion of some waste for recycling. Many incinerators, however, are not designed for energy recovery, but to simply reduce the volume of waste destined for a landfill. For such incinerators, the reduction in waste resulting from recycling is not a major concern.

Another useful product obtained from mixed refuse is compost. Compost is derived from the organic fraction of the refuse, usually after most of the inorganic materials, such as glass, metals, and plastics have been removed. The controlled biological decomposition of the organics produces a very good soil conditioner that can be used in agriculture and in the reclamation of poor soils. Contamination with non-degradable materials reduces the quality of the compost and can even present a hazard for people and grazing animals. Thus, quality control is very important. In Alberta, long, cold winters may limit the potential for extensive composting operations. However, composting can still contribute to Alberta's solid waste management program.

4. SUMMARY AND QUESTIONS FOR CONSIDERATION

The consumption of consumer goods is heavily promoted in our society and large amounts of material are subsequently discarded as waste. Public attitudes towards solid waste are generally negative and most people would prefer to have little to do with this inevitable phenomenon. Municipal solid waste contains a variety of materials, many of which have value in the marketplace. By recycling these materials, waste management costs can be reduced while conserving energy and natural resources.

Most people support the concept of recycling, but such support does not always translate into recycling action. There are many ways of motivating people to recycle, such as prompting, monetary incentives, peer pressure, legislation, and others. Many people recycle to conserve our natural resources or to benefit charitable groups. Are these more effective incentives than cash-for-trash? Knowledge of *how* to recycle and convenient opportunities to contribute materials facilitate participation. How can recycling be encouraged in your community?

Recycling is already a part of Alberta society. Many Albertans recycle within their homes and communities. Local paper and bottle drives generate important revenues for non-profit community groups. There may be ways of improving the effectiveness of these drives. Should community drives be coordinated by the sponsoring groups?...local government?...the companies that purchase the material? Or is the present system adequate? An extensive bottle depot system recovers large quantities of beverage containers. Other systems exist to collect scrap metal, waste oil, textiles, and other materials. Should a deposit-refund system be applied to other materials?

Many Alberta companies utilize the supply of secondary materials in the manufacture of glass, steel, building products, motor oil, and many other products. Recycling industries furnish employment for many Albertans and some provide important training for workers with special needs. However, the exploitation of *primary* natural resources contributes more to the Alberta economy. Should the government encourage competition from secondary materials?

Recycling depends upon the participation and support of individuals. Does that support exist in your community? What barriers exist to more recycling activity? There are many unanswered questions about the desire or need for more recycling in Alberta. Many social, economic, and environmental benefits can be derived from recycling. Can recycling be encouraged to further increase these benefits? Your views on these and related questions will assist the Environment Council's panel on recycling to develop recommendations that will help the provincial government to plot the future direction of recycling in Alberta. The Environment Council of Alberta looks forward to hearing from you.

References

Alberta Environment. 1978. *Drayton Valley Recycling Project. Final Report.* Pollution Control Division, Alberta Department of the Environment. Edmonton. 35 pages.

Bealer, R.C., K.E. Martin, and D.M. Crider. 1982. *Sociological Aspects of Siting Facilities for Solid Waste Disposal : A State-of-the-Art Study and Annotated Bibliography.* Report No. 158. Department of Agricultural Economics and Rural Sociology, Pennsylvania State University. University Park, Penn. 88 pages.

Bird and Hale Ltd.; Clarke, Derzko and Associates Ltd.; and L.S. Love and Associates (Canada) Ltd. 1979. *Municipal Refuse Statistics for Canadian Communities of Over 100,000 (1976-1977).* EPS 3-EC-79-9. Environmental Protection Service, Canada Department of the Environment. Ottawa. 41 pages.

Carson, G. 1984. "Update on Recycling in Fredericton, New Brunswick." In *Proceedings, 5th Annual Conference*, pages 39-54. Recycling Council of Ontario. Toronto. 84 pages.

Chandler, W.U. 1983. *Materials Recycling : the Virtue of Necessity.* Worldwatch Paper 56. Worldwatch Institute. Washington, D.C. 52 pages.

Cone, J.D. and S.C. Hayes. 1977. "Applied Behavior Analysis and the Solution to Environmental Problems." In *Human Behavior and Environment : Advances in Theory and Research, Volume 2*, I. Altman and J.F. Wohlwill, eds., pages 129-179, New York: Plenum Press. 341 pages.

---- 1980. *Environmental Problems/Behavioral Solutions.* Monterey, California: Brookes/Cole Publishing Co. 284 pages.

Cooper, R.M. 1982. "A Survey of Mandatory Recycling Ordinances." *Resource Recycling* I(2): 12 (May/June).

De Young, R. 1984. "Motivating People to Recycle: The Use of Incentives." *Resource Recycling* III(2): 14 (May/June).

F.C. Haussmann Consulting. 1979. *Attitudes Towards Post-Consumer Products in Ontario.* Ontario Ministry of the Environment and Waste Management Advisory Board. Toronto. 64 pages.

Free, B. 1985. *Municipal Solid Waste – Alberta's Untapped Resource?* ECA85-18/IB3. Edmonton: Environment Council of Alberta. 36 pages.

Goldstein, N. 1984. "New Jersey Acts to Avoid Landfill Crisis." *Biocycle* 25(6): 20-24 (Nov/Dec).

Gravelines, G. 1985. "Recycling in Alberta." *Environment Views* 8(4): 16.

Hertzberg, R. 1983. "Islip, New York: Where Mandatory Recycling Works." *Resource Recycling* II(2): 17 (May/June).

Humphrey, C.R., G.R. Harris, and S.H. Mann. 1978-79. "Sociological Aspects of Waste Paper Recovery." *Journal of Environmental Systems* 8(2): 111-126.

Intercept Research Corporation and Brian Gard Inc. 1984. *Recycling Attitudes and Behavior.* Lake Oswego, Oregan: Publishers Paper Company. 124 pages.

Kairow, I. 1984. Unpublished report to the City Services Committee re the status of recycling in Toronto. Nov. 20, 1984. Toronto Recycling Action Committee. Toronto. 5 pages plus appendix.

Kennedy, K. 1978. "Oil Re-refining." *Environment Views* 1(1): 22-23.

Leung, E. 1985. Unpublished minutes from the September 18 meeting of the Greater Vancouver Regional District Recycling Committee.

Lilley, J. 1985. *Resource Recycling in Alberta.* ECA85-18/IB1. Edmonton: Environment Council of Alberta. 60 pages.

Ludolph, N. 1984. "Kitchener's Source Separation Recycling Programme." In *Speakers' Outlines, 6th Annual Conference on Waste Management in Canada.* November 7-9, 1984. Canadian Public Works Council (APWA); City of Vancouver; Canada Department of the Environment; Government Refuse Collection and Disposal Association (GRCDA), British Columbia Chapter; National Solid Wastes Management Association; and British Columbia Ministry of the Environment. Vancouver. Various pagination.

Luyben, P.D., S.B. Warren, and T.A. Tallman. 1979-80. "Recycling Beverage Containers on a College Campus." *Journal of Environmental Systems* 9(2): 189-202.

Meadows, D.L. and D.H. Meadows. 1972. *Limits to Growth.* A Potomac Associates Book. New York: Universe Books. 205 pages.

Nielsen, J.M. and B.L. Ellington. 1983. "Social Processes and Resource Conservation: A Case Study in Low Technology Recycling." In *Environmental Psychology: Directions and Perspectives,* N.R. Feimer and E.S. Geller, eds., pages 288-312. New York: Praeger Publishers. 356 pages.

Organisation for Economic Co-operation and Development (OECD). 1983. *Household Waste: Separate Collection and Recycling.* Organisation for Economic Co-operation and Development. Paris. 141 pages.

Oregon Department of Environmental Quality. 1985. *Recycling Survey.* Information letter. Solid Waste Division, Oregon Department of Environmental Quality. Portland, Oregon. 7 pages.

Powell, J. 1984. "Recycling and Waste-to-Energy: An Overview." In *Speakers' Outlines, 6th Annual Conference on Waste Management in Canada.* November 7-9, 1984. Canadian Public Works Council (APWA); City of Vancouver, Canada Department of the Environment, Government Refuse Collection and Disposal Association (GRCDA), British Columbia Chapter; National Solid Wastes Management Association; and British Columbia Ministry of the Environment. Vancouver. Various pagination.

Recycling Council of Ontario. 1985. "Lower Mainland Studies Options." *Ontario Recycling Update* V(1): 5.

Resource Recycling. 1982. "The Public's Opinion of Recycling." I(2): 6-7 (May/June).

Science Council of Canada. 1977. *Canada As a Conserver Society: Resource Uncertainties and the Need for New Technologies.* Report No. 27. Science Council of Canada. Ottawa. 108 pages.

SECOR. 1984. *Comportement, Opinions et Preferences de la Population du Quebec Concernant la Recuperation et le Recyclage des Contenants Uni-services.* Le Groupe de Travail sur la Recuperation des Contenants Uni-services. Montreal. 70 pages plus appendices.

Seldman, N. and T. Ferrand. 1982. "Local Legislation Boosting Recycling." *Biocycle* 23(1): 48 (Jan/Feb).

Strategic Development Services Ltd. 1985. *The Domestic Waste Recycling Industry in Alberta.* Alberta Environmental Research Trust. Calgary. 131 pages plus appendices.

Weigel, R.H. 1983. "Environmental Attitudes and the Prediction of Behaviour." In *Environmental Psychology: Directions and Perspectives,* N.R. Feimer and E.S. Geller, eds., pages 257-287. New York: Praeger Publishers. 356 pages.